

ANNA UNIVERSITY CHENNAI :: CHENNAI 600 025

AFFILIATED INSTITUTIONS

CURRICULUM – R 2008

B.E MECHANICAL ENGINEERING

**SEMESTER-VI**

Code No.	Course Title	L	T	P	C
<b>THEORY</b>					
MG 2351	<a href="#">Principles of Management</a>	3	0	0	3
ME 2351	<a href="#">Gas Dynamics &amp; Jet Propulsion</a>	3	1	0	4
ME 2352	<a href="#">Design of Transmission Systems</a>	3	1	0	4
ME 2354	<a href="#">Automobile Engineering</a>	3	0	0	3
ME 2353	<a href="#">Finite Element Analysis</a>	3	1	0	4
	Elective – I	3	0	0	3
<b>PRACTICALS</b>					
ME 2355	<a href="#">Thermal Engineering Laboratory – II</a>	0	0	3	2
ME 2356	<a href="#">Design &amp; Fabrication Project</a>	0	0	4	2
GE 2321	<a href="#">Communication Skills Laboratory</a>	0	0	3	2
	<b>TOTAL</b>	<b>18</b>	<b>3</b>	<b>10</b>	<b>27</b>

**SEMESTER-VII**

Code No.	Course Title	L	T	P	C
<b>THEORY</b>					
GE 2022	<a href="#">Total Quality Management</a>	3	0	0	3
ME 2401	<a href="#">Mechatronics</a>	3	0	0	3
ME 2402	<a href="#">Computer Integrated Manufacturing</a>	3	0	0	3
ME 2403	<a href="#">Power Plant Engineering</a>	3	0	0	3
	Elective – II	3	0	0	3
	Elective – III	3	0	0	3
<b>PRACTICALS</b>					
ME 2404	<a href="#">Computer Aided Simulation &amp; Analysis Laboratory</a>	0	0	3	2
ME 2405	<a href="#">Mechatronics Laboratory</a>	0	0	3	2
	<b>TOTAL</b>	<b>18</b>	<b>0</b>	<b>6</b>	<b>22</b>

**SEMESTER-VIII**

Code No.	Course Title	L	T	P	C
<b>THEORY</b>					
MG 2451	<a href="#">Engineering Economics &amp; Cost Analysis</a>	3	0	0	3
	Elective – IV	3	0	0	3
	Elective - V	3	0	0	3
<b>PRACTICALS</b>					
ME 2452	<a href="#">Comprehension</a>	0	0	3	2
ME 2453	<a href="#">Project Work</a>	0	0	6	12
<b>TOTAL</b>		<b>9</b>	<b>0</b>	<b>9</b>	<b>23</b>

**LIST OF ELECTIVES****SEMESTER-VI**

Code No.	Course Title	L	T	P	C
<b>THEORY</b>					
MG 2021	<a href="#">Marketing Management</a>	3	0	0	3
ME 2021	<a href="#">Quality Control &amp; Reliability Engineering</a>	3	0	0	3
ME 2022	<a href="#">Refrigeration &amp; Air conditioning</a>	3	0	0	3
ME 2023	<a href="#">Renewable Sources of Energy</a>	3	0	0	3
ME 2024	<a href="#">Industrial Tribology</a>	3	0	0	3
ME 2025	<a href="#">Vibration &amp; Noise Control</a>	3	0	0	3
ME 2026	<a href="#">Unconventional Manufacturing Processes</a>	3	0	0	3

**SEMESTER-VII**

Code No.	Course Title	L	T	P	C
<b>THEORY</b>					
ME 2027	<a href="#">Process Planning &amp; Cost Estimation</a>	3	0	0	3
ME 2028	<a href="#">Robotics</a>	3	0	0	3
ME 2029	<a href="#">Design of Jigs, Fixtures &amp; Press Tools</a>	3	0	0	3
ME 2030	<a href="#">Composite Materials</a>	3	0	0	3
ME 2031	<a href="#">Thermal Turbomachines</a>	3	0	0	3
ME 2032	<a href="#">Computational Fluid Dynamics</a>	3	0	0	3
ME 2034	<a href="#">Nuclear Engineering</a>	3	0	0	3

**SEMESTER-VIII**

Code No.	Course Title	L	T	P	C
<b>THEORY</b>					
GE 2021	<a href="#">Professional Ethics In Engineering</a>	3	0	0	3
GE2023	<a href="#">Fundamentals of Nanoscience</a>	3	0	0	3
ME 2035	<a href="#">Entrepreneurship Development</a>	3	0	0	3
ME 2036	<a href="#">Production Planning &amp; Control</a>	3	0	0	3
ME 2037	<a href="#">Maintenance Engineering</a>	3	0	0	3
ME 2038	<a href="#">Operations Research</a>	3	0	0	3
ME 2040	<a href="#">Design of Pressure vessel and piping</a>	3	0	0	3
ME 2041	<a href="#">Advanced I.C. Engines</a>	3	0	0	3
ME 2042	<a href="#">Design of Heat Exchangers</a>	3	0	0	3

**UNIT I                    OVERVIEW OF MANAGEMENT                    9**

Definition - Management - Role of managers - Evolution of Management thought - Organization and the environmental factors – Trends and Challenges of Management in Global Scenario.

**UNIT II                    PLANNING                    9**

Nature and purpose of planning - Planning process - Types of plans – Objectives - Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions.

**UNIT III                    ORGANIZING                    9**

Nature and purpose of organizing - Organization structure - Formal and informal groups / organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - Performance Appraisal.

**UNIT IV                    DIRECTING                    9**

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories - Leadership Styles - Leadership theories - Communication - Barriers to effective communication - Organization Culture - Elements and types of culture - Managing cultural diversity.

**UNIT V                    CONTROLLING                    9**

Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

**TOTAL= 45 PERIODS**

**TEXT BOOKS:**

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', McGraw Hill Education, Special Indian Edition, 2007.

**REFERENCES:**

1. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management - A global & Entrepreneurial Perspective', Tata McGraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.

**AIM:**

- To impart knowledge to the students on compressible flow through ducts, jet propulsion and space propulsion.

**OBJECTIVE:**

- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.

**UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 6**

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers – Use of Gas tables.

**UNIT II FLOW THROUGH DUCTS 9**

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties – Use of tables and charts – Generalised gas dynamics.

**UNIT III NORMAL AND OBLIQUE SHOCKS 10**

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

**UNIT IV JET PROPULSION 10**

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

**UNIT V SPACE PROPULSION 10**

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

**TUTORIALS: 15 TOTAL: 60 PERIODS****TEXT BOOKS:**

1. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3<sup>rd</sup> Edition, 2003.
2. H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 1980.
3. S.M. Yahya, fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 1996.

**REFERENCES:**

1. P. Hill and C. Peterson, Mechanics and Thermodynamics of Propulsion, Addison – Wesley Publishing company, 1992.
2. N.J. Zucrow, Aircraft and Missile Propulsion, vol.1 & II, John Wiley, 1975.
3. N.J. Zucrow, Principles of Jet Propulsion and Gas Turbines, John Wiley, New York, 1970.

4. G.P. Sutton, Rocket Propulsion Elements, John Wiley, 1986, New York.
5. A.H. Shapiro, Dynamics and Thermodynamics of Compressible fluid Flow, John Wiley, 1953, New York.
6. V. Ganesan, Gas Turbines, Tata McGraw Hill Publishing Co., New Delhi, 1999.
7. P.R.S.L. Somasundaram, Gas Dynamics and Jet Propulsions, New Age International Publishers, 1996.
8. V. Babu, Fundamentals of Gas Dynamics, ANE Books India, 2008.

**ME2352**

**DESIGN OF TRANSMISSION SYSTEMS**

**L T P C**  
**3 1 0 4**

**OBJECTIVE:**

- To gain knowledge on the principles and procedure for the design of power Transmission components. To understand the standard procedure available for Design of Transmission slip terms To learn to use standard data and catalogues

**UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 9**

Selection of V belts and pulleys-selection of Flat belts and pulleys-Wire ropes and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

**UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9**

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.

**UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 9**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears.

Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

**UNIT IV DESIGN OF GEAR BOXES 9**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

**UNIT V DESIGN OF CAM CLUTCHES AND BRAKES 9**

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses.

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes.

**TUTORIALS: 15 TOTAL: 60 PERIODS**

**NOTE:** (Usage of P.S.G Design Data Book is permitted in the University examination)

**TEXT BOOKS:**

1. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw-Hill , 2003.
2. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

**REFERENCES:**

1. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 1985.
2. Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., 1994.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000,
4. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw-Hill Book Co., 1999.
5. Ugural A,C, "Mechanical Design, An Integrated Approach", McGraw-Hill , 2003.

**STANDARDS:**

1. IS 4460 : Parts 1 to 3 : 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity.
2. IS 7443 : 2002, Methods of Load Rating of Worm Gears
3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, PI and PM Profiles : Dimensions
4. IS 2122 : Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 1 Flat Belt Drives.
5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 2 V-Belt Drives.

**ME2353****FINITE ELEMENT ANALYSIS****L T P C****3 1 0 4****INTRODUCTION** (Not for examination)**5**

Solution to engineering problems – mathematical modeling – discrete and continuum modeling – need for numerical methods of solution – relevance and scope of finite element methods – engineering applications of FEA

**UNIT I                      FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS**
**5+3**

Weighted residual methods –general weighted residual statement – weak formulation of the weighted residual statement –comparisons – piecewise continuous trial functions-example of a bar finite element –functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – finite element method – application to bar element

**UNIT II                      ONE DIMENSIONAL FINITE ELEMENT ANALYSIS**
**8+4**

General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions – element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods –beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems

**UNIT III            TWO DIMENSIONAL FINITE ELEMENT ANALYSIS            10+4**

Introduction – approximation of geometry and field variable – 3 noded triangular elements – four noded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – iso-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – need for quadrature formulæ – transformations to natural coordinates – Gaussian quadrature – example problems in plane stress, plane strain and axisymmetric applications

**UNIT IV            DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD            8+4**

Introduction – vibrational problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations – solution of eigenvalue problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods

**UNIT V            APPLICATIONS IN HEAT TRANSFER & FLUID MECHANICS            6+3**

One dimensional heat transfer element – application to one-dimensional heat transfer problems- scalar variable problems in 2-Dimensions – Applications to heat transfer in 2-Dimension – Application to problems in fluid mechanics in 2-D

**L=42, T=18 TOTAL:60 PERIODS**

**TEXT BOOK:**

1. P.Seshu, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007. ISBN-978-203-2315-5

**REFERENCES:**

1. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions(Engineering Mechanics Series), 1993. ISBN-0-07-051355-4
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3<sup>rd</sup> Edition, Prentice-Hall of India, Eastern Economy Editions. ISBN-978-81-203-2106-9
3. David V.Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005. ISBN-0-07-239536-2
4. Cook,Robert.D., Plesha,Michael.E & Witt,Robert.J. "Concepts and Applications of Finite Element Analysis",Wiley Student Edition, 2004. ISBN-10 81-265-1336-5

## UNIT I VEHICLE STRUCTURE AND ENGINES

9

Types of automobiles , vehicle construction and different layouts ,chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine-their forms ,functions and materials

## UNIT II ENGINE AUXILIARY SYSTEMS

9

Electronically controlled gasoline injection system for SI engines., Electronically controlled diesel injection system ( Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system ,Turbo chargers, Engine emission control by three way catalytic converter system .

## UNIT III TRANSMISSION SYSTEMS

9

Clutch-types and construction ,gear boxes- manual and automatic, gear shift mechanisms.

Over drive, transfer box, fluid flywheel –torque converter , propeller shaft, slip joints, universal joints ,Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive.

## UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS

9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems , Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control

## UNIT V      ALTERNATIVE ENERGY SOURCES

9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol , Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance ,Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell

**Note:** A Practical Training in dismantling and assembling of engine parts and transmission systems may be given to the students.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Kirpal Singh, “ Automobile Engineering Vols 1 & 2 “, Standard Publishers, Seventh Edition ,1997, New Delhi
2. Jain,K.K.,and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi. 2002

## REFERENCES:

1. Newton ,Steeds and Garet,” Motor Vehicles “, Butterworth Publishers,1989
2. Joseph Heitner, “Automotive Mechanics,” Second Edition ,East-West Press ,1999
3. Martin W. Stockel and Martin T Stockle , “ Automotive Mechanics Fundamentals,” The Goodheart –Will Cox Company Inc, USA ,1978
4. Heinz Heisler , ‘Advanced Engine Technology,” SAE International Publications USA,1998
5. Ganesan V..” Internal Combustion Engines” , Third Edition, Tata Mcgraw-Hill ,2007



**LIST OF EXPERIMENTS****HEAT TRANSFER 30**

Thermal conductivity measurement by guarded plate method  
Thermal conductivity of pipe insulation using lagged pipe apparatus  
Natural convection heat transfer from a vertical cylinder  
Forced convection inside tube  
Heat transfer from pin-fin (natural & forced convection modes)  
Determination of Stefan-Boltzmann constant  
Determination of emissivity of a grey surface  
Effectiveness of parallel/counter flow heat exchanger

**REFRIGERATION AND AIR CONDITIONING 15**

Determination of COP of a refrigeration system  
Experiments on air-conditioning system  
Performance test on single/two stage reciprocating air compressor.

**TOTAL: 45 PERIODS****LIST OF EQUIPMENT**

(for a batch of 30 students)

- |   |         |
|---|---------|
| 1. Guarded plate apparatus                        | – 1 No. |
| 2. Lagged pipe apparatus                          | – 1 No. |
| 3. Natural convection-vertical cylinder apparatus | – 1 No. |
| 4. Forced convection inside tube apparatus        | – 1 No. |
| 5. Pin-fin apparatus                              | – 1 No. |
| 6. Stefan-Boltzmann apparatus                     | – 1 No. |
| 7. Emissivity measurement apparatus               | – 1 No. |
| 8. Parallel/counter flow heat exchanger apparatus | – 1 No. |
| 9. Single/two stage reciprocating air compressor. | – 1 No. |
| 10. Refrigeration test rig                        | – 1 No. |
| 11. Air-conditioning test rig                     | – 1 No. |

**ME2356****DESIGN AND FABRICATION PROJECT****L T P C****0 0 4 2****(COMMON TO MECHANICAL AND PRODUCTION)**

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to practical problems.

The students in convenient groups of not more than 4 members have to take one small item for design and fabrication. Every project work shall have a guide who is the member of the faculty of the institution and if possible with an industry guide also.

The item chosen may be small machine elements (Example-screw jack, coupling, machine vice, cam and follower, governor etc), attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic /pneumatic devices etc.

The students are required to design and fabricate the chosen item in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings, process charts relating to fabrication.

**GE2321****COMMUNICATION SKILLS LABORATORY  
(Fifth / Sixth Semester)****L T P C****0 0 4 2**

Globalisation has brought in numerous opportunities for the teeming millions, with more focus on the students' overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the industry environment, thus rendering them as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them in their profession.

**OBJECTIVES:**

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

**I. PC based session****(Weightage 40%)****24 periods****A. ENGLISH LANGUAGE LAB****(18 Periods)**

**1. LISTENING COMPREHENSION:** (6)  
Listening and typing – Listening and sequencing of sentences – Filling in the blanks -  
Listening and answering questions.

**2. READING COMPREHENSION:** (6)  
Filling in the blanks - Close exercises – Vocabulary building - Reading and answering  
questions.

**3. SPEAKING:** (6)  
Phonetics: Intonation – Ear training - Correct Pronunciation – Sound recognition  
exercises – Common Errors in English.

Conversations: Face to Face Conversation – Telephone conversation – Role play  
activities (Students take on roles and engage in conversation)

**B. DISCUSSION OF AUDIO-VISUAL MATERIALS (6 PERIODS)**

(Samples are available to learn and practice)

**1. RESUME / REPORT PREPARATION / LETTER WRITING** (1)  
Structuring the resume / report - Letter writing / Email Communication - Samples.

**2. PRESENTATION SKILLS:** (1)  
Elements of effective presentation – Structure of presentation - Presentation  
tools – Voice Modulation – Audience analysis - Body language – Video samples

**3. SOFT SKILLS:** (2)  
Time management – Articulateness – Assertiveness – Psychometrics –  
Innovation and Creativity - Stress Management & Poise - Video Samples

**4. GROUP DISCUSSION:** (1)  
Why is GD part of selection process ? - Structure of GD – Moderator – led and  
other GDs - Strategies in GD – Team work - Body Language - Mock GD -Video  
samples

**5. INTERVIEW SKILLS:** (1)  
Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews-  
Video samples.

II. Practice Session	(Weightage – 60%)	24 periods
1. Resume / Report Preparation / Letter writing: Students prepare their own resume and report.	(2)	
2. Presentation Skills: Students make presentations on given topics.	(8)	
3. Group Discussion: Students participate in group discussions.	(6)	
4. Interview Skills: Students participate in Mock Interviews	(8)	

**TEXT BOOKS**

1. Anderson, P.V, **Technical Communication**, Thomson Wadsworth, Sixth Edition, New Delhi, 2007.
2. Prakash, P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., Second Edition, New Delhi, 2004.

**REFERENCES:**

1. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi, 2004.
2. Evans, D, **Decisionmaker**, Cambridge University Press, 1997.
3. Thorpe, E, and Thorpe, S, **Objective English**, Pearson Education, Second Edition, New Delhi, 2007.
4. Turton, N.D and Heaton, J.B, **Dictionary of Common Errors**, Addison Wesley Longman Ltd., Indian reprint 1998.

**LAB REQUIREMENTS:**

1. Teacher console and systems for students.
2. English Language Lab Software
3. Career Lab Software

**Requirement for a batch of 60 students**

Sl.No.	Description of Equipment	Quantity required
1.	<b>Server</b>	1 No.
	o PIV system	
	o 1 GB RAM / 40 GB HDD	
	o OS: Win 2000 server	
	o Audio card with headphones (with mike)	
	o JRE 1.3	
2.	Client Systems	60 No.
	o <b>PIII or above</b>	
	o <b>256 or 512 MB RAM / 40 GB HDD</b>	
	o <b>OS: Win 2000</b>	
	o Audio card with headphones (with mike)	
	o JRE 1.3	
3.	<b>Handicam Video Camera (with video lights and mic input)</b>	1 No.
4.	Television - 29"	1 No.
5.	Collar mike	1 No.
6.	Cordless mikes	1 No.
7.	Audio Mixer	1 No.
8.	DVD Recorder / Player	1 No.
9.	LCD Projector with MP3 /CD /DVD provision for audio / video facility - <b>Desirable</b>	1 No.

**UNIT I INTRODUCTION 9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

**UNIT II TQM PRINCIPLES 9**

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS & TECHNIQUES I 9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

**UNIT IV TQM TOOLS & TECHNIQUES II 9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

**UNIT V QUALITY SYSTEMS 9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Dale H.Besterfield, et., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

**REFERENCE BOOKS:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6<sup>th</sup> Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3<sup>rd</sup> Edition, 2003.
3. Suganthi, L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman, B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. L

(COMMON TO MECHANICAL AND PRODUCTION- VI SEMESTER)

- UNIT I                    MECHATRONICS, SENSORS AND TRANSDUCERS                    9**  
Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors
- UNIT II                    ACTUATION SYSTEMS                    9**  
Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor – AC & DC Servo motors
- UNIT III                    SYSTEM MODELS AND CONTROLLERS                    9**  
Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.
- UNIT IV                    PROGRAMMING LOGIC CONTROLLERS                    9**  
Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC.
- UNIT V                    DESIGN OF MECHATRONICS SYSTEM                    9**  
Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot-Wireless surveillance balloon- Engine Management system- Automatic car park barrier.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Bolton, W, "Mechatronics" , Pearson education, second edition, fifth Indian Reprint, 2003
2. Smaili, A and Mrad, F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008

**REFERENCES:**

1. Rajput, R.K, A textbook of mechatronics, S. Chand & Co, 2007
2. Michael B. Histan and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.

- |        |                                   |         |
|--------|-----------------------------------|---------|
| ME2402 | COMPUTER INTEGRATED MANUFACTURING | L T P C |
|        |                                   | 3 0 0 3 |

- This course will enable the student
- To gain knowledge about the basic fundamental of CAD.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

CIM as a concept and a technology, CASA/Sme model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM

History Of Group Technology – role of G.T in CAD/CAM Integration – part families-classification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing.Process planning - role of process planning in CAD/CAM Integration – approaches to computer aided process planning – variant approach and generative approaches – CAPP and CMPP systems.

shop floor control – phases – factory data collection system – automatic identification methods – Bar code technology – automated data collection system.  
FMS – components of FMS – types – FMS workstation – material handling and storage system – FMS layout- computer control systems – applications and benefits.

**UNIT V                      COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING                      9**

Production planning and control – cost planning and control – inventory management – material requirements planning (MRP) – shop floor control. Lean and Agile Manufacturing. Types of production monitoring systems – structure model of manufacturing – process control and strategies – direct digital control.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education 2001.

**REFERENCES:**

1. Mikell. P. Groover and Emory Zimmers Jr., “CAD/CAM”, Prentice hall of India Pvt. Ltd., 1998.
2. James A. Regh and Henry W. Kreabber, “Computer Integrated Manufacturing”, Pearson Education second edition, 2005.
3. Chris McMahon and Jimmie Browne, “CAD CAM Principles, Practice and Manufacturing Management”, Pearson Education second edition, 2005.
4. Ranky, Paul G., “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd., 2005.
5. Yorem Koren, “ Computer Integrated Manufacturing”, McGraw Hill, 2005.
6. P N Rao, “ CAD/CAM Principles and Applications”, TMH Publications, 2007.

**ME2403                      POWER PLANT ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To understand the various components , operations and applications of different types of power plants

**UNIT I                      INTRODUCTION TO POWER PLANTS AND BOILERS                      9**

Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine Power Plants Combined Power cycles – comparison and selection , Load duration Curves, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidised Bed Boilers

**UNIT II                      STEAM POWER PLANT                      9**

Fuel and ash handling ,Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught- Different Types, Surface condenser types, cooling Towers

**UNIT III                      NUCLEAR AND HYDEL POWER PLANTS                      9**

Nuclear Energy-Fission , Fusion Reaction, Types of Reactors, Pressurized water reactor ,Boiling water reactor, Waste disposal and safety Hydel Power plant- Essential elements, Selection of turbines, governing of Turbines- Micro hydel developments



**UNIT IV            DIESEL AND GAS TURBINE POWER PLANTS            9**

Types of diesel plants, components , Selection of Engine type, applications-Gas turbine power plant- Fuels- Gas turbine material – open and closed cycles- reheating – Regeneration and intercooling – combines cycle

**UNIT V            OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS    9**

Geo thermal- OTEC- tidal- Pumped storage –Solar central receiver system Cost of electric Energy- Fixed and operating costs-Energy rates- Types tariffs- Economics of load sharing, comparison of various power plants.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Arora S.C and Domkundwar S, “A Course in Power Plant Engineering”, Dhanpat Rai , 2001
2. Nag P.K ,”Power Plant Engineering”. Third edition Tata McGraw- Hill ,2007

**REFERENCES:**

1. El-Wakil M.M ,Power “Plant Technology,” Tata McGraw-Hill 1984
2. K.K.Ramalingam , “ Power Plant Engineering “, Scitech Publications, 2002
3. G.R,Nagpal , “Power Plant Engineering”, Khanna Publishers 1998
4. G.D.Rai, “Introduction to Power Plant Technology” Khanna Publishers,1995

<b>ME2404</b>	<b>COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY</b>	<b>L T P C 0 0 3 2</b>
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**LIST OF EXPERIMENTS**

**A.            SIMULATION            8**

Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Lab.  
Simulation of Hydraulic / Pneumatic cylinder using C / MAT Lab.  
Simulation of cam and follower mechanism using C / MAT Lab.

**B.            ANALYSIS (SIMPLE TREATMENT ONLY)            37**

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket
3. Stress analysis of an axi-symmetric component
4. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
5. Mode frequency analysis of a 2 D component
6. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component

**TOTAL: 45 PERIODS**

## LIST OF EQUIPMENTS

(For a batch of 30 students)

Computer System	30
17" VGA Color Monitor	
Pentium IV Processor	
40 GB HDD	
512 MB RAM	
Color Desk Jet Printer	01
Software	
Suitable analysis software	30 licenses
C / MATLAB	5 licenses

**ME2405**

**MECHATRONICS LABORATORY**

**L T P C**  
**0 0 3 2**

(COMMON TO MECHANICAL AND PRODUCTION VI SEMESTER)

## LIST OF EXPERIMENTS

- Design and testing of fluid power circuits to control  
(i) velocity (ii) direction and (iii) force of single and double acting actuators
- Design of circuits with logic sequence using Electro pneumatic trainer kits.
- Simulation of basic Hydraulic, Pneumatic and Electric circuits using software
- Circuits with multiple cylinder sequences in Electro pneumatic using PLC
- Speed Control of AC & DC drives
- Servo controller interfacing for DC motor
- PID controller interfacing
- Stepper motor interfacing with 8051 Micro controller  
(i) full step resolution (ii) half step resolution
- Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW
- Computerized data logging system with control for process variables like pressure flow and temperature.

**TOTAL: 45 PERIODS**

## LIST OF EQUIPMENT

(For a batch of 30 students)

- |   |         |
|---|---------|
| 1. Basic Pneumatic Trainer Kit with manual and electrical controls/<br>PLC Control each                         | - 1 No. |
| 2. Basic Hydraulic Trainer Kit  | - 1 No. |
| 3. Hydraulics and Pneumatics Systems Simulation Software /<br>Automation studio sets                            | - 10 No |
| 4. 8051 - Microcontroller kit with stepper motor and drive circuit sets   | - 2 No. |
| 5. LAB VIEW software with Sensors to measure Pressure,<br>Flow rate, direction, speed, velocity and force.seats | - 2 No. |

**(COMMON TO MECHANICAL, PRODUCTION, AUTOMOBILE, METALLURGY, MECHATRONICS - VIII SEMESTER ELECTIVE)**

**OBJECTIVES:**

To learn about the basics of economics and cost analysis related to engineering so as to take economically sound decisions.

**UNIT I INTRODUCTION TO ECONOMICS 8**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics- Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

**UNIT II VALUE ENGINEERING 10**

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

**UNIT III CASH FLOW 9**

Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

**UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9**

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

**UNIT V DEPRECIATION 9**

Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.
2. Suma Damodaran, " Managerial economics", Oxford university press 2006.

**REFERENCES:**

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1976.
5. Smith, G.W., "Engineering Economy", Iowa State Press, Iowa, 1973.
6. Truett & Truett, " Managerial economics- Analysis, problems & cases " Wiley India 8<sup>th</sup> edition 2004.
7. Luke M Froeb / Brian T Mccann, " Managerial Economics – A problem solving approach" Thomson learning 2007.

**ME2452****COMPREHENSION****L T P C**  
**0 0 3 2****OBJECTIVE:**

- The objective of comprehension is to provide opportunity for the student to apply the knowledge acquired during the earlier semesters to real life problems which he / she may have to face in future as an engineer.
- While learning as how to solve the real life problems, student will receive guidance from the faculty and also review various courses learnt earlier.
- Further this comprehension is to achieve an understanding of the fundamentals of contemporary manufacturing systems including materials, manufacturing process, product and process control, computer integrated manufacture and quality.
- The students work in groups and solve a variety of problems given to them.
- The problems given to the students should be of real like industrial problems selected by a group of faculty members of the concerned department.
- A minimum of three small problems have to be solved by each group of students. The evaluation is based on continuous assessment by a group of Faculty Members constituted by the professor in-charge of the course.

**ME2453****PROJECT WORK****L T P C**  
**0 0 6 12****OBJECTIVE:**

- The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the branch of study.
- Every project work shall have a guide who is the member of the faculty of the institution.
- Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Govindarajan. M, "Marketing management – concepts, cases, challenges and trends", Prentice hall of India, second edition 2007.
2. Philip Kotler, Koshy Jha "Marketing Management", Pearson Education , Indian adapted edition. 2007

**REFERENCES:**

1. Ramasamy and Nama kumari, "Marketing Environment: Planning, implementation and control the Indian context", 1990.
2. Czinkota & Kotabe, "Marketing management", Thomson learning, Indian edition 2007
3. Adrain palmer, " Introduction to marketing theory and practice", Oxford university press IE 2004.
4. Donald S. Tull and Hawkins, "Marketing Research", Prentice Hall of India-1997.
5. Philip Kotler and Gary Armstrong "Principles of Marketing" Prentice Hall of India, 2000.
6. Steven J. Skinner, "Marketing", All India Publishers and Distributors Ltd. 1998.
7. Graeme Drummond and John Ensor, Introduction to marketing concepts, Elsevier, Indian Reprint, 2007

**ME2021                      QUALITY CONTROL AND RELIABILITY ENGINEERING                      L T P C**  
**3 0 0 3**

**(COMMON TO MECHANICAL, AUTOMOBILE AND PRODUCTION)**

**OBJECTIVE:**

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

**UNIT I                      INTRODUCTION AND PROCESS CONTROL FOR VARIABLES                      10**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process-causes of variation – Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and  $\sigma$  chart -process capability – process capability studies and simple problems. Six sigma concepts.

**UNIT II                      PROCESS CONTROL FOR ATTRIBUTES                      8**

Control chart for attributes – control chart for non conformings– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

**UNIT III                      ACCEPTANCE SAMPLING                      9**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

## 9

## UNIT V      QUALITY AND RELIABILITY

9

**TOTAL: 45 PERIODS**

## TEXT BOOKS

- ## REFERENCES

- ME 2022

## REFRIGERATION AND AIR CONDITIONING

**LTPC**  
**3003**

**AIM:**

- To reach the underlying principles of operation in different Refrigeration & Air conditioning systems and components.

### OBJECTIVES:

- To provide knowledge on various refrigeration cycles, system components and refrigerants. To provide knowledge on design aspects of Refrigeration & Air conditioning Systems.

## UNIT I REFRIGERATION CYCLE

7

Review of thermodynamic principles of refrigeration. Carnot refrigeration cycle – Vapour compression refrigeration cycle – use of P.H. charts – multistage and multiple evaporator systems – cascade system – COP comparison. Air Refrigeration cycles.

**UNIT II            REFRIGERANTS AND SYSTEM COMPONENTS            10**

Compressors – reciprocating and rotary (elementary treatment), Types of condensers, evaporators, cooling towers – Functional aspects. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls.

**UNIT III            PSYCHROMETRY            10**

Psychrometric processes use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers, requirements of comfort air conditioning, summer and Winter Air conditioning.

**UNIT IV            AIR CONDITIONING SYSTEMS            9**

Cooling load calculation working principles of – Centralized Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts.

**UNIT V            UNCONVENTIONAL REFRIGERATION CYCLES            9**

Vapor Absorption system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. APPLICATIONS – ice plant – food storage plants – milk – chilling plants.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 1983.
2. Arora C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1988.

**REFERENCES:**

1. Roy. J. Dossat, "Principles of Refrigeration", Pearson Education 1997.
2. Jordon and Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Pvt. Ltd., New Delhi, 1985.
3. Stoecker N.F. and Jones, "Refrigeration and Air Conditioning", TMH, New Delhi, 1981.

**ME 2023            RENEWABLE SOURCES OF ENERGY**

**L T P C  
3 0 0 3**

**AIM:**

- To instruct the importance of renewable energy and its utilization for the thermal and electrical energy needs and also the environmental aspects of these resources.

**OBJECTIVE:**

At the end of the course, the student expected to do Understand and analyze the pattern of renewable energy resources Suggest methodologies / technologies for its utilization Economics of the utilization and environmental merits

**UNIT I            SOLAR ENERGY            9**

Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications.



Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems.

Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics.

Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues.

Hydrogen, generation, storage, transport and utilization, Applications : power generation, transport – Fuel cells – technologies, types – economics and the power generation

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
2. S.P. Sukhatme, Solar Energy, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1997.

## REFERENCES:

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
3. G.N. Tiwari, solar Energy – Fundamentals Design , Modelling and applications, Narosa Publishing House, New Delhi, 2002.
4. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.

ME2024

## INDUSTRIAL TRIBOLOGY

LTPC  
3 0 0 3

## UNIT I SURFACES AND FRICTION 9

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction – Adhesion-Ploughing- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

## UNIT II WEAR 9

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

**UNIT III                    LUBRICANTS AND LUBRICATION TYPES                    9**

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication.

**UNIT IV                    FILM LUBRICATION THEORY                    9**

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram.

**UNIT V                    SURFACE ENGINEERING AND MATERIALS FOR BEARINGS                    9**

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1.A.Harnoy “ Bearing Design in Machinery “Marcel Dekker Inc,NewYork,2003

**REFERENCES:**

1. M.M.Khonsari & E.R.Booser, “ Applied Tribology”,John Willey &Sons,New York,2001
2. E.P.Bowden and D.Tabor., "Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.
3. A.Cameron, " Basic Lubrication theory ", Longman, U.K., 1981.
4. M.J.Neale (Editor), " Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1995.

**ME2025                    VIBRATION AND NOISE CONTROL                    L T P C**  
**(COMMON TO MECHANICAL AND AUTOMOBILE)                    3 0 0 3**

**OBJECTIVES:**

- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

**UNIT I                    BASICS OF VIBRATION                    9**

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

**UNIT II                    BASICS OF NOISE                    9**

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise.

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

1. Singiresu S.Rao - "Mechanical Vibrations" - Pearson Education, ISBN –81-297-0179-0 - 2004.
2. Kewal Pujara "Vibrations and Noise for Engineers", Dhanpat Rai & Sons, 1992.

1. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book" - Second edition - SAE International - ISBN 0-7680-0403-9 – 1999.
2. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth-Heinemann, ISBN 0750-5044-3 - 2004
3. John Fenton - "Handbook of Automotive body Construction and Design Analysis - Professional Engineering Publishing, ISBN 1-86058-073- 1998.

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

## Unconventional machining Process – Need – classification – Brief overview .

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used – Applications.

**UNIT III ELECTRICAL ENERGY BASED PROCESSES 8**  
 Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

**UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 12**  
 Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants-maskant-techniques of applying maskants-Process Parameters – Surface finish and MRR-Applications. Principles of ECM-equipments-Surface Roughness and MRR-Electrical circuit-Process Parameters-ECG and ECH - Applications.

**UNIT V THERMAL ENERGY BASED PROCESSES 10**  
 Laser Beam machining and drilling (LBM), plasma arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007

**REFERENCES:**

1. Benedict. G.F. “Nontraditional Manufacturing Processes” Marcel Dekker Inc., New York (1987).
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi (2007).
3. Mc Geough, “Advanced Methods of Machining” Chapman and Hall, London (1998).
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., New Delhi ,8<sup>th</sup> Edition,2001.

**ME2027 PROCESS PLANNING AND COST ESTIMATION L T P C**  
 (COMMON TO MECHANICAL AND PRODUCTION - CORE) **3 0 0 3**

**OBJECTIVE:**

- To introduce the process planning concepts to make cost estimation for various products after process planning

**UNIT I WORK STUDY AND ERGONOMICS 10**  
 Method study – Definition – Objectives-Motion economy- Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time –Ergonomics – principles – applications.

**UNIT II PROCESS PLANNING 10**  
 Definition – Objective – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection – material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes.

**UNIT III INTRODUCTION TO COST ESTIMATION 7**  
Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost.

**UNIT IV COST ESTIMATION 8**  
Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation.

**UNIT V PRODUCTION COST ESTIMATION 10**  
Estimation of material cost, labour cost and over heads, allocation of overheads – Estimation for different types of jobs.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 1995

**REFERENCES:**

1. Phillip.F Ostwalal and Jairo Munez, "Manufacturing Processes and systems", John Wiley, 9<sup>th</sup> Edition, 1998
2. Russell.R.S and Tailor, B.W, "Operations Management", PHI, 4<sup>th</sup> Edition, 2003.
3. Chitale.A.V. and Gupta.R.C., "Product Design and Manufacturing", PHI, 2<sup>nd</sup> Edition, 2002.

**ME2028 ROBOTICS L T P C**  
**3 0 0 3**  
**(COMMON TO MECHANICAL, AUTOMOBILE AND PRODUCTION - CORE)**

**OBJECTIVES:**

- To understand the basic concepts associated with the design and functioning and applications of Robots To study about the drives and sensors used in Robots
- To learn about analyzing robot kinematics and robot programming

**UNIT I FUNDAMENTALS OF ROBOT 7**  
Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots – Different Applications

**UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 10**  
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

**UNIT III SENSORS AND MACHINE VISION 10**  
Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders,

Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors, (Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction: Edge detection, Feature Extraction and Object Recognition – Algorithms. Applications – Inspection, Identification, Visual Servoing and Navigation.

#### **UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10**

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effector commands, and Simple programs

#### **UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 8**

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

**TOTAL: 45 PERIODS**

#### **TEXT BOOK:**

1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001

#### **REFERENCES:**

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
2. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
3. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 1995

**ME 2029**

**DESIGN OF JIGS, FIXTURES & PRESS TOOLS**

**L T P C  
3 0 0 3**

#### **OBJECTIVES:**

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

#### **UNIT I LOCATING AND CLAMPING PRINCIPLES: 8**

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

**UNIT II JIGS AND FIXTURES 10**

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

**UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 10**

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

**UNIT IV BENDING FORMING AND DRAWING DIES 10**

Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing reverse re-drawing and combination dies – Blank development for ax- symmetric, rectangular and elliptic parts – Single and double action dies.

**UNIT V MISCELLANEOUS TOPICS 7**

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke - Course should be supplemented with visits to industries.

(Use of Approved design Data Book permitted).

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Donaldson, Lecain and Goold "Tool Design", III rd Edition Tata McGraw Hill, 2000.

**REFERENCES:**

1. K. Venkataraman, "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.
2. Kempster, "Jigs and Fixture Design", Hoddes and Stoughton – Third Edition 1974.
3. Joshi, P.H. "Press Tools" – Design and Construction", Wheels publishing, 1996.
4. Hoffman "Jigs and Fixture Design" – Thomson Delmar Learning, Singapore, 2004.
5. ASTME Fundamentals of Tool Design Prentice Hall of India.
6. Design Data Hand Book, PSG College of Technology, Coimbatore.

**OBJECTIVES:**

- To understand the fundamentals of composite material strength and its mechanical behavior Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

**UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 12**

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix ( $Q_{ij}$ ), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes

**UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 10**

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

**UNIT III LAMINA STRENGTH ANALYSIS 5**

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

**UNIT IV THERMAL ANALYSIS 8**

Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

**UNIT V ANALYSIS OF LAMINATED FLAT PLATES 10**

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

**TOTAL: 45 PERIODS**



**TEXT BOOK:**

1. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994, Second Edition - CRC press in progress.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998

**REFERENCES:**

1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
2. Mallick, P.K., Fiber –Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.
4. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

**ME 2031****THERMAL TURBOMACHINES****L T P C  
3 0 0 3****AIM:**

To instruct the importance of the principles of various turbomachines

**OBJECTIVE:**

To understand the various systems, principles, operations and applications of different types of turbo machinery components.

**UNIT I PRINCIPLES 9**

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

**UNIT II CENTRIFUGAL FANS AND BLOWERS 9**

Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

**UNIT III CENTRIFUGAL COMPRESSOR 9**

Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

**UNIT IV AXIAL FLOW COMPRESSOR 9**

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.

**UNIT V AXIAL AND RADIAL FLOW TURBINES 9**

Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Yahya, S.H., Turbines, Compressors and Fans, Tata McGraw-Hill Publishing Company, 1996.

**REFERENCES:**

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
3. Dixon, S.I., Fluid Mechanics and Thermodynamics of Turbomachinery, Pergamon Press, 1990.
4. Shepherd, D.G., Principles of Turbomachinery, Macmillan, 1969.
5. Stepanpff, A.J., Blowers and Pumps, John Wiley and Sons Inc. 1965.
6. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.
7. Gopalakrishnan .G and Prithvi Raj .D, A Treatise on Turbomachines, Scitech Publications (India) Pvt. Ltd., 2002.

**ME 2032****COMPUTATIONAL FLUID DYNAMICS****L T P C  
3 0 0 3****AIM:**

- To impart the knowledge of numerical techniques to the solution of fluid dynamics and heat transfer problems.

**OBJECTIVE:**

To introduce Governing Equations of viscous fluid flows

- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

**PREREQUISITE:**

Fundamental Knowledge of partial differential equations, Heat Transfer and Fluid Mechanics

**UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8**

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

**UNIT II FINITE DIFFERENCE METHOD 9**

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Boundedness, Transportiveness. Hybrid, Power-law, QUICK Schemes.

Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, Two equation (k- $\epsilon$ ) models – High and low Reynolds number models

1. T.J. Chung, Computational Fluid Dynamics, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The finite volume Method, Longman, 1998.
3. Ghoshdastidar , P.S., computer Simulation of flow and heat transfer, Tata McGraw Hill Publishing Company Ltd., 1998.

1. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., computational Fluid Flow and Heat Transfer, Narosa Publishing House, NewDelhi, 1995.
3. Ghoshdastidar P.S., Heat Transfer, Oxford University Press, 2005.
4. Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
5. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.

**LTPC**  
**3 0 0 3**

To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

**UNIT II      NUCLEAR REACTIONS AND REACTION MATERIALS      9**

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

**UNIT III   REPROCESSING      9**

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

**UNIT IV   NUCLEAR REACTOR      9**

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

**UNIT V   SAFETY AND DISPOSAL      9**

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

**TOTAL : 45 PERIODS**

**TEXT BOOKS**

1. Thomas J.Cannoly, "Fundamentals of nuclear Engineering" John Wiley 1978.

**REFERENCES**

1. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York. 1987
2. Wakil M.M.El., "Power Plant Technology" – McGraw-Hill International, 1984.

**ME2034**

**NUCLEAR ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.

**UNIT I      NUCLEAR PHYSICS      9**

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

**UNIT II      NUCLEAR REACTIONS AND REACTION MATERIALS      9**

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

**UNIT III      REPROCESSING      9**

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

**TEXT BOOKS:**

1. Thomas J.Cannoly, "Fundamentals of nuclear Engineering" John Wiley 1978.

1. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York. 1987
2. Wakil M.M.El., "Power Plant Technology" – McGraw-Hill International, 1984.

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics -  
Role in Technological Development – Weapons Development – Engineers as Managers  
– Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty –  
Moral Leadership – Sample Code of Conduct

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, (2000).

**REFERENCES:**

- Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
1. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
  2. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
  3. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
  4. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

**GE2023**

**FUNDAMENTALS OF NANOSCIENCE**

**L T P C  
3 0 0 3**

**UNIT I INTRODUCTION 9**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II PREPARATION METHODS 10**

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 7**

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

**UNIT IV PREPARATION ENVIRONMENTS 9**

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

**UNIT V CHARACTERISATION TECHNIQUES 10**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale charecterisation of surfaces & Interfaces", 2<sup>nd</sup> Edition, Weinheim Cambridge, Wiley-VCH, 2000

**REFERENCES:**

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

**ME2035**

**ENTREPRENEURSHIP DEVELOPMENT**  
(COMMON TO ALL BRANCHES)

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

**UNIT I ENTREPRENEURSHIP 9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

**UNIT II MOTIVATION 9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, self Rating, Business Game, Thematic Apperception Test – Stress management, Entrepreneurship Development Programs – Need, Objectives.

**UNIT III BUSINESS 9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

**UNIT IV FINANCING AND ACCOUNTING 9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

**UNIT V SUPPORT TO ENTREPRENEURS 9**

Sickness in small Business – Concept, Magnitude, causes and consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. S.S.Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Kuratko & Hodgetts, "Enterprenuership – Theory, process and practices", Thomson learning 6<sup>th</sup> edition.

#### **REFERENCES:**

1. Hisrich R D and Peters M P, "Entrepreneurship" 5<sup>th</sup> Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2<sup>nd</sup> edition 2006.
3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
4. EDII " Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.

**ME2036**

**PRODUCTION PLANNING AND CONTROL**

**L T P C  
3 0 0 3**

#### **OBJECTIVE:**

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

#### **UNIT I INTRODUCTION**

**9**

Objectives and benefits of planning and control-Functions of production control-Types of production-job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration-Standardization, Simplification & specialization-Break even analysis-Economics of a new design.

#### **UNIT II WORK STUDY**

**9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

#### **UNIT III PRODUCT PLANNING AND PROCESS PLANNING**

**9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning-Steps in process planning-Quantity determination in batch production-Machine capacity, balancing-Analysis of process capabilities in a multi product system.

#### **UNIT IV PRODUCTION SCHEDULING**

**9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling-Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control-Material requirement planning kanban –



Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

**UNIT V                      INVENTORY CONTROL AND RECENT TRENDS IN PPC                      9**

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems-elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Martand Telsang, "Industrial Engineering and Production Management", S. Chand and Company, First edition, 2000.
2. James.B.Dilworth,"Operations management – Design, Planning and Control for manufacturing and services" McGraw Hill International edition 1992.

**REFERENCES:**

1. Samson Eilon, "Elements of production planning and control", Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8<sup>th</sup> Ed. John Wiley and Sons, 2000.
3. Kanishka Bedi, " Production and Operations management", Oxford university press, 2<sup>nd</sup> Edition 2007.
4. Melynk, Denzler, " Operations management – A value driven approach" Irwin McGrawhill.
5. Norman Gaither, G. Frazier, " operations management" Thomson learning 9<sup>th</sup> edition IE, 2007
6. K.C.Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
7. S.N.Chary, "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
8. Upendra Kachru, " Production and operations management – Text and cases" Excel books 1<sup>st</sup> edition 2007.

**ME2037**

**MAINTENANCE ENGINEERING**

**L T P C  
3 0 0 3**

**(COMMON TO MECHANICAL AND PRODUCTION)**

**OBJECTIVES:**

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry.

**UNIT I                    PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING                    10**

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

**UNIT II                    MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE                    9**

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

**UNIT III                    CONDITION MONITORING                    9**

Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

**UNIT IV                    REPAIR METHODS FOR BASIC MACHINE ELEMENTS                    10**

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

**UNIT V                    REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT                    8**

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., 1981
2. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995

**REFERENCES:**

- White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979.
1. Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.
  2. Higgins L.R., “Maintenance Engineering Hand book”, McGraw Hill, 5th Edition, 1988.
  3. Armstrong, “Condition Monitoring”, BSIRSA, 1988.
  4. Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 1996.
  5. “Advances in Plant Engineering and Management”, Seminar Proceedings - IIPE, 1996.

**(COMMON TO MECHANICAL, METALLURGY, AUTOMOBILE & MECHATRONICS)**

### OBJECTIVE:

- To create awareness about optimisation in utilization of resources.
- To understand and apply operations research techniques to industrial operations.

<b>UNIT I</b>	<b>LINEAR MODEL</b>	<b>10</b>
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The phases of OR study – formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method, Duality in LPP. Transportation problems- VAM – MODI technique, Assignment problems.

## UNIT II NETWORK MODELS 8

Shortest route – minimal spanning tree - maximum flow models – project network- CPM and PERT network-critical path scheduling.

## UNIT II INVENTORY MODEL 9

Types of Inventory- EOQ –ERL- Deterministic inventory problems – Price breaks - Stochastic inventory problems- selective inventory control techniques.

## UNIT II                  REPLACEMENT MODELS    9

Replacement of items that deteriorate with time – value of money changing with time – not charging with time – optimum replacement policy – individual and group replacement. Sequencing problem: models with  $n$  jobs with 2 machines – problem with  $n$  jobs with  $m$  machines.

## UNIT III QUEUING THEORY 9

Queuing models – queuing systems and structures – notation – parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Wayne.L.Winston, Operations research applications and algorithms, Thomson learning, 4<sup>th</sup> edition 2007.
2. Taha H.A, "Operation Research", Pearson Education, sixth edition, 2003

## REFERENCES:

1. Frederick.S.Hiller and Gerald.J.Lieberman, "Operations research concepts and cases", TMH (SIE) 8<sup>th</sup> edition.
2. J.K.Sharma, "Operations research theory and applications", Macmillan India 3<sup>rd</sup> edition 2007,
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co,2002.
4. Panneerselvam, "Operations Research" Prentice Hall of India, 2003.
5. G Srinivasan, "Operations research principles and applications", PHI (EEE) 2007.
6. Wagner, "Operations Research", Prentice Hall of India, 2000.

**AIM:**

- To give exposure to various types of process equipments and their design.

**OBJECTIVES:**

- To understand the different types of stresses and their effects in pressure vessel.
- To understand the piping layout and the stresses acting on it.

**UNIT I CYLINDRICAL SHELL AND VARIOUS CLOSURES 9**

Membrane theory for thin shells, stresses in cylindrical, spherical and conical shells, dilation of above shells, general theory of membrane stresses in vessel under internal pressure and its application to ellipsoidal and torispherical end closures. Bending of circular plates and determination of stresses in simply supported and clamped circular plate. Introduction to ASME code and formulae

**UNIT II JUNCTION STRESSES, OPENING AND REINFORCEMENTS 9**

Discontinuity stresses. Stress concentration in plate having circular hole due to bi-axial loading. Theory of reinforced opening and reinforcement limits.

**UNIT III SUPPORT DESIGN 9**

Supports for vertical & horizontal vessels. Design of base plate and support lugs. Types of anchor bolt, its material and allowable stresses. Design of saddle supports.

**UNIT IV BUCKLING IN VESSELS 9**

Buckling of vessels under external pressure. Elastic buckling of long cylinders, buckling modes, Collapse under external pressure. Design for stiffening rings. Buckling under combined external pressure and axial loading.

**UNIT V PIPING STRESS ANALYSIS 9**

Flow diagram, Piping layout and piping stress analysis. Flexibility factor and stress intensification factor. Design of piping system as per B31.1 piping code. Piping components – bends, tees, bellows and valves. Types of piping supports and their behaviour.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Harvey J F , 'Pressure vessel design' CBS publication
2. Brownell. L. E & Young. E. D , 'Process equipment design', Wiley Eastern Ltd., India

**REFERENCES:**

1. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
2. American standard code for pressure piping , B 31.1
3. Henry H Bednar, Pressure vessel Design Hand book,CBS publishers and distributors
4. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths, series in Chemical Engineering,1988
5. William.j.,Bees,"Approximate methods in the Design and Analysis of pressure vessels and piping", ASME Pressure vessels and piping conference,1997

<b>UNIT I</b>	<b>SPARK IGNITION ENGINES</b>	<b>9</b>
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Air-fuel ratio requirements, Design of carburetor –fuel jet size and venture size, Stages of combustion-normal and abnormal combustion, Factors affecting knock, Combustion chambers, Introduction to thermodynamic analysis of SI Engine combustion process.

## UNIT II                      COMPRESSION IGNITION ENGINES                      9

Stages of combustion-normal and abnormal combustion – Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Turbo charging , Introduction to Thermodynamic Analysis of CI Engine Combustion process.

## UNIT III ENGINE EXHAUST EMISSION CONTROL 9

Formation of  $\text{NO}_x$ , HC/CO mechanism, Smoke and Particulate emissions, Green House Effect, Methods of controlling emissions, Three way catalytic converter and Particulate Trap, Emission (HC, CO, NO and  $\text{NO}_x$ ) measuring equipments, Smoke and Particulate measurement. Indian Driving Cycles and emission norms

## UNIT IV ALTERNATE FUELS 9

Alcohols , Vegetable oils and bio-diesel, Bio-gas, Natural Gas , Liquefied Petroleum Gas ,Hydrogen , Properties , Suitability, Engine Modifications, Performance , Combustion and Emission Characteristics of SI and CI Engines using these alternate fuels.

## UNIT V RECENT TRENDS 9

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine ,Stratified Charge Engine, Surface Ignition Engine , Four Valve and Overhead cam Engines, Electronic Engine Management, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine , Data Acquisition System –pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines.

**TOTAL =45 PERIODS**

**TEXT BOOK:**

1. 1 Heinz Heisler , 'Advanced Engine Technology," SAE International Publications ,USA,1998
2. 2 .Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill .2007

## REFERENCES:

1. John B Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill 1988
2. Patterson D.J. and Henein N.A, "Emissions from combustion engines and their control," Ann Arbor Science publishers Inc, USA, 1978
3. Gupta H.N, "Fundamentals of Internal Combustion Engines", Prentice Hall of India, 2006
4. Ulrich Adler, "Automotive Electric / Electronic Systems, Published by Robert Bosch GmbH, 1995

**AIM:**

To build up necessary background for the design of various types of heat exchangers.

**OBJECTIVES:**

- To learn the sizing of heat exchangers, thermal and mechanical stress analysis for various heat exchange applications.

**UNIT I                      DIFFERENT CLASSIFICATION OF HEAT EXCHANGERS                      9**

Parallel flow, counter flow and cross flow; shell and tube and plate type; single pass and multipass; once through steam generators etc;

**UNIT II                      PROCESS DESIGN OF HEAT EXCHANGERS                      9**

Heat transfer correlations, Overall heat transfer coefficient, LMTD, sizing of finned tube heat exchangers, U tube heat exchangers, fouling factors, pressure drop calculations.

**UNIT III                      MECHANICAL DESIGN OF SHELL AND TUBE TYPE                      9**

Thickness calculation, Tubesheet design using TEMA formula, concept of equivalent plate for analysing perforated analysis, flow induced vibration risks including acoustic issues and remedies, tube to tubesheet joint design, buckling of tubes, thermal stresses

**UNIT IV                      COMPACT AND PLATE HEAT EXCHANGER                      9**

Types – Merits and Demerits – Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations

**UNIT V                      CONDENSORS AND COOLING TOWERS                      9**

Design of surface and evaporative condensers – cooling tower –performance characteristics

**TOTAL : 45 PERIODS**

**TEXT BOOKS / REFERENCES:**

1. T.Taborek, G.F.Hewitt and N.Afgan, Heat Exchangers, Theory and Practice, McGraw-Hill Book Co.1980.
2. Walker, Industrial Heat Exchangers- A Basic Guide, Mc Graw Hill Book Co. 1980
3. Nicholas Cheremistoff, Cooling Tower, Ann Arbor Science Pub 1981
4. Arthur, P. Frass, Heat Exchanger Design, John Wiley and Sons, 1988
5. J.P. Gupta, Fundamentals of heat exchangers and pressure vessel technology, Hemisphere publishing corporation, Springer-Verlag (outside NA), 1986
6. Donald Q. Kern and Alban D. Kraus, "Extended surface hear transfer" Mc Graw Hill Book Co., 1972
7. E.A.D. Sanders, Heat Exchangers, Selection Design and Construction Layman Scientific & Technical; co published with John Wiley & sons, 1988